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## ABSTRACT

### A Critical Examination of Economic Research in Procurement: An Economic and Military Perspective

First Lieutenant Daniel L. Allen, USAF  
Major Report for Non-Thesis Master of Arts Program  
Department of Economics  
The Ohio State University  
July, 1994

Efficiency in procurement has always been a popular topic among analysts at many different levels and agencies. Over the years, a set of broad generalizations about the nature of the defense industry and the flaws of the acquisition process have developed and are widely taken as given in even the most rigorous economic analysis. These characterizations of the defense industry and the procurement process are examined critically. In addition I survey the economic literature in procurement. I find that much of the theoretical literature simply accepts the conventional wisdom about the defense business, thus adding a caveat to a great deal of the results obtained through sound economic analysis. I conclude that future research needs to focus more on defining the process and what drives behavior that has occurred for decades. Such normative analysis is necessary before any policy recommendations should be made. I suggest one approach is to do an empirical comparison between defense and private sector procurement of the same product in an effort define a specific problem before trying to solve it. This paper was done as a starting point for a future dissertation proposal.

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**A Critical Examination of Research in Procurement: An Economic and Military  
Perspective**

**First Lieutenant Daniel L. Allen Jr.  
Department of Economics  
The Ohio State University  
13 July 1994**

## **I. Introduction**

For the United States military, defense industry, and national security policy makers, the post cold war era has been a difficult time. On one hand, the world environment is a volatile one. There is conflict and uncertainty worldwide, and the entire world still looks to this nation for leadership. On the other hand, the defense budget has been on a downward spiral since the late 1980's in response to the fall of the Soviet Union. Thus the entire defense community is faced with some very hard choices that have been well publicized, in the form of base closure hearings, program cancellations, job losses, and political rhetoric on technology conversion.

The issue of what the United States national security policy will be is still in debate, and this is a question not easily answered. There is no question the military will have to continue its downsizing. Since readiness to defend this nation is the top priority of the military, a clear objective is to make the most of the limited funding available. A seemingly obvious response to this challenge is to suggest acquisition reform to "cut waste" in the Pentagon. For years, we have heard the horror stories of fraud, abuse, and opportunism by both the defense contractors and the government agents working with them. The criticisms are well documented, as people talk of the high price tags and inefficiently long acquisition process.

Economists have demonstrated a vivid interest in the area of procurement research, as there is a vast literature devoted to the topic. A typical procurement paper picks an aspect of the acquisition process, lays out the correct incentive structure, makes recommendations for reform, and then proceeds to list all of the reasons why the government can't do it this way. These "laundry lists" are usually quoted from policy oriented books on the defense industry, which seek to describe the nature of the military business and explain how it has come to be the way it is, while also recommending reforms. In all of the procurement literature, broad generalizations about acquisition seem to drive the research. It is not the aim of this paper to recommend acquisition reform, or

even to suggest reform is necessary. The goal of this work is to take a closer look at the conclusions about the defense industry and the procurement process. This will be a starting point of an effort to simply define a problem area in defense acquisition.

## II. The Nature of the Defense Industry

Before any endeavor is made to examine the way military procurement works, it is necessary to understand the defense industry itself, as many have said it differs greatly from any commercial industry for several reasons. Arguably the biggest factor in this relationship is the degree of control that a defense contractor subjects itself to by the federal government. In their book Defense Acquisition Management, General George Sammet Jr. and Colonel David Green state, "Although defense is not a regulated industry, it is controlled by the government as though it were. All effort is controlled through congressional legislation and regulations such as the Federal Acquisition Regulation (87)."

It is a commonly held belief the above statement by Sammet and Green is true. Government red tape and inefficiencies in procurement is a subject that is often made light of. But is red tape unique to the Department of Defense? One would not dispute the notion of government interference in many private endeavors. Further, the possibility for similar obstacles in a relationship between two private firms in perhaps a producer-supplier arrangement seems almost as likely. I think one would be naive to think excess control is unique to the defense industry. Still, this is a legitimate problem in a contracting process, so we will examine it further.

How do these conditions arise? A good place to start is the seller-buyer relationship. The government is a monopsonist who demands products that are not yet designed or have little pricing precedence. The highly sophisticated weapons systems developed for our nation begin at a conceptual stage where the technology is untested or not even in place yet. With this technological uncertainty and little prior experience to base a contractual agreement on, it is very difficult to write a firm contract where both parties

agree on issues such as cost estimates, profit to the contractor, and performance delivered to the government. Again, I question whether this is a problem unique to the defense industry. Any new technology involves considerable uncertainty, and there are many products that are every bit as sophisticated as a new weapons system. While it may be hard (but surely not impossible) to duplicate the monopsony of the government, there is still a great deal of risk a company faces in developing a new product, and not all work is done in house, so there are contractual issues to be resolved in the private sector as well.

Risk sharing is a big issue in the defense industry. In private industry, a corporation bears most of the risk itself in developing a new product. An externality arises in that defense is a public good. Since a weapons system is so specialized that there is only one potential customer, a rare buyer-seller risk-sharing arrangement is born. Due to all of this uncertainty, the need for regulation arises out of fear of opportunistic behavior on the government side and the fear of "being left out in the cold" after spending billions in research and development on the contractor side. The result has been the rise of government-oriented corporations so specialized they are locked in to government work. An interesting result is that not only does the firm depend on the government for business but vice versa (Weidenbaum 132).

This line of reasoning by Weidenbaum seems to suggest that only the defense industry faces buyer-seller dependence. While I do agree the severity of the problem may be enhanced by government regulations, I think it is easy to point to similar arrangements in the private sector. In the auto industry, General Motors used to depend on Fisher Body for all of its automobile bodies. Fisher was able to make a product only for GM, exactly to their specifications, while acting as GM's exclusive supplier. Both firms feared being at the mercy of the other if they signed a short term contract, while fearing cost/price uncertainty in drawing up a long term contract. They did enter into a ten year arrangement in 1919, but conditions changed and the two firms merged in 1926 (Klein, Crawford, and Alchian, 309-310). This is a good example of the "unique" arrangement

Weidenbaum cites.

Further even the argument about risk sharing seems shaky. Research and development is an area of well documented externalities. There is a concern over spillovers and free riding by other firms on one hand, while R&D expenditures have the potential to make one firm more profitable, having a negative strategic effect on the other firm. Thus new product development is an extremely risky venture in any industry. There are concerns on proprietary information, timing, and potential demand. At least the defense firm can be relatively certain its product will be sold (once the contract is awarded). Again, all new product development is not done in house. It would be interesting to look at contractual issues in research and development in the private sector.

As a result of the "unique" customer-supplier relationship that is borne out of idiosyncratic weapons systems and the need for risk sharing, several other characteristics of the defense industry arise. It should be noted that the term "defense industry" is used loosely in this analysis. In truth there are very few firms who do exclusively defense business. Instead there are thousands of subcontractors who do mostly civilian work, and few government products are produced by just one firm. But Weidenbaum suggests defense contracts are kept as a separate division of most firms because of the unique requirements and characteristics of the business which include: simple channels of distribution, large fixed costs, limited marketing capabilities, and a highly specialized labor force (136).

The above list of factors are among those simply taken for granted. What is meant by simple channels of distribution? Again, I do not think this is unique to the defense industry. Does the airline industry face the same problems as its divisions that build military aircraft? Its channels of distribution seem equally simple. In the automotive industry, cars are shipped to dealers where the franchises are independently responsible for selling them. This doesn't seem much different from delivering tanks to various Army installations. What about a computer firm who is under contract to supply computers for

a large corporation? How is that different from a computer firm who is under contract to supply the Air Force? These are examples of comparisons that need to be made before concluding the defense business is unique in its channels of distribution.

The next factor is large fixed costs. It is ludicrous to assume this makes the defense industry unique. In developing arguments on barriers to entry, economists list several prominent industries with relatively few firms such as the auto industry. The fixed costs in this market are enormous. The telecommunications industry and any other utilities are sometimes referred to as natural monopolies due to the nature of the product and the fixed costs involved. In addition, large fixed costs is a very vague description. Again, a comparison would be useful.

Weidenbaum cites limited marketing capabilities. I would be interested to take a look at lobbying expenditures for the defense industry. The nature of this industry is boom and bust. For example the Air Force only develops a new fighter aircraft perhaps once a decade at most. Thus the pressure to get the contract is immense. Thus, I would argue defense firms are very skilled in marketing their product, although the nature of these efforts differ from conventional advertising. Still, the expenditure on proposals and lobbying might be counted as an advertising expenditure.

I don't think a highly specialized labor force is unique to the defense industry either. The computer industry could easily make a similar argument, just to name one. The point is, a closer look at the arguments given on procurement can lead to much more insight into ways to determine what the real forces that drive the process are.

While the above factors are questionable in understanding the defense industry, it is my belief that the biggest factor in procurement is the government's demand for quality and performance. Due to the uncertainty previously described, the offer price has little importance in a weapons program. The United States Air Force does not want the second fastest fighter aircraft in the world, at any savings. This may be a generalization, but past behavior has proved it so. Often more important than cost estimation in the process is the

contractor's past record in technical achievement and meeting government requirements. This well documented "quality bias" lead Weidenbaum to conclude that "major suppliers of weapons systems are quality maximizers rather than cost minimizers" (135). Again, this conclusion should not go unchallenged. Studies have been done documenting the fact that the military will spend a lot to gain a little in terms of performance. Perhaps this is also true in certain private sector industries, especially in high-tech, fast moving enterprises where patent race situations are involved. For example, how much was spent to develop the Pentium microchip, and how does that compare to the quality bias by the military?

All of the above characteristics of the defense industry have contributed to the heavy government regulation of the defense acquisition process. Many have listed the above characteristics and pointed to the government control in concluding the defense industry is in its own league. Such analysis stops short. Is the defense industry as unique as many people think? For each idiosyncratic aspect listed, I provided a potential challenge. The government has done business this way for a long time, as Scherer documented many of the above concerns as early as 1964 in his book, The Weapons Acquisition Process: Economic Incentives. When the same behavior has been persistent for such a long time, but yet criticized for such a long time, it seems logical to conclude that the true problem (if there is a problem) has not been defined. If people are rational, then why does this behavior persist? There must be an explanation. Hence the next step is to dig deeper into how the federal government does business.

### **III. The Procurement Process**

In general there are two types of defense contracts. The first is a cost reimbursement contract, often called cost plus fixed fee. This type of agreement is typically used for development and initial production phases, since the uncertainties run high at this point. In this arrangement the government pays the contractor's costs plus some negotiated premium. It should be noted that the government has become very strict

in what they consider reimbursable costs, as a result of the 1986 Packard Commission on acquisition reform. One would think this contract would lack incentives, as the government is bearing so much of the risk, but the burden is on the contractor to perform so well that the government decides to go forward with full scale production. There are also some cost-reimbursable contracts that contain incentive provisions for cost control where the producer can keep part of any cost savings but must bear part of any cost overruns. These provisions are limited, as every contract has allowable floors and ceilings on the profits (Weidenbaum 140).

The second class of contract is a fixed fee arrangement. Here the price is set at the outset, and the contract contains more incentive provisions. There is no floor protecting the contractor's profits, so it is clearly more favorable from a cost control perspective. There is no provision for price adjustments. But because the contractor bears more risk, the government must pay a higher target fee than the cost based contracts. There has been a bias towards fixed-price contracts in the Pentagon as seventy-nine percent were of that nature in 1988 (Weidenbaum 141). Defense industry officials believe this is impractical from the perspective of both sides because it is so hard to estimate costs up front, especially on a new system with untested technology. Weidenbaum states the DoD is moving away from this reliance on fixed-price contracts due to an erosion in contractor earnings (141).

Today, a substantial number of contracts are awarded through a competitive process of some sort. This is a result of the Competition in contracting Act of 1984. Prior to 1984, almost no contracts were awarded in competitive bidding. By 1988, approximately one-half of all military contracts awarded were a result of competitive bidding. Competition does not necessarily mean a sealed bid. Often negotiations take place with no formal advertising. This is argued as acceptable due to the specialized nature of the business. The legislation did set up a formal protest mechanism for firms who felt they were victimized by favoritism. One area where competitive bidding is not



common is in follow-on orders. In these cases, DoD often argues that the previous firm has already met fixed costs and has been the beneficiary of some learning.

So far, none of this sounds too unreasonable. What goes wrong? The 1986 Packard Commission reported that the Department of Defense wastes twenty to thirty cents on every dollar it spends (Weidenbaum 151). In examining the inefficiency, one of the biggest reasons for the waste is gross over management of the process that leads to delays and higher costs. Thus a good place to start is with the Federal Acquisition Regulation, known as FAR. It was created in an attempt to streamline government procurement by combining the procurement regulations of NASA, DoD, and the General Services Administration. This seems like a good idea, but then the Department of Defense had to put its stamp on it, so they issued the Federal Acquisition Regulation Supplement, or DAR. The results are astounding. Federal Procurement generates around 290 million hours of paperwork a year. DoD, while accounting for 77 percent of procurement, is responsible for an estimated 90 percent of the paperwork (Weidenbaum 153).

The Defense Acquisition Regulation is larger than Webster's unabridged dictionary. It contains seventy parts, twelve appendices, and two separate manuals, one on pricing and one on small purchases. FAR and DAR do not tell the whole story. Each service has a massive body of auxiliary commands and regulations including court decisions and service specific directives. The Navy reports that its existing legislation and case law covering its procurement alone covers 1,152 linear feet of library shelf space. Weidenbaum cites a 1987 report by the Defense Department's inspector general that concluded 45 percent of all procurement regulations violated established criteria for writing such regulations (154). As a result, the Office of Federal Procurement Policy reported that 881 pages of regulations had been eliminated and another 816 had been changed or simplified. That leaves only 30,000 pages of regulations that need to be re-evaluated (Weidenbaum 154).

At this point, there is an inherent conflict in the analysis. On one hand, the

conclusions about the defense industry being unique are vague and questionable. On the other hand, the above statistics on the amount of regulation in procurement are staggering. Thus, a big step in getting to the bottom of what drives this process is to take a hard look at the sources of regulation. Weidenbaum again summarizes the problem with four categories: the vastness of military enterprise; Congressional desire to micromanage; the imposition of socioeconomic objectives; and human shortcomings (154).

The first of Weidenbaum's four categories of procurement complexity is the vastness of military enterprise. The military does not just buy weapons. It purchases tens of thousands of items that can be found in the civilian marketplace. But the DAR is so specific, it borders on the ludicrous. The DoD contract for milk has fifteen clauses in addition to the regulation "bakery and dairy products contracts." These clauses cover everything from delivery vehicles and time to containers and equipment. They are so specific that they tell the contractor exactly how to draw a sample for testing, depending on the size of the carton (Weidenbaum 155). The laundry service is another example. A bundle of clothing must contain exactly thirteen pieces of clothing and colors must be sorted from whites (Weidenbaum 156).

All of these specifications are laid out in the government's solicitation for bids, known as the Request for Proposal. On a technical project, the RFP is typically 1,000 to 2,000 pages long. The specifications for sugar cookies were 15 pages and in a comical example, Weidenbaum cites the requirements for fruitcake which state, "the presence of vanilla flavoring shall be organoleptically detected, but not to a pronounced degree" (165).

These requests for proposals lead to detailed proposals from three or four firms. The proposals for the C-5A transport aircraft totalled 240,000 pages. Weidenbaum goes on to note that many firms who produce a product for both the military and civilian customers will do so in separate divisions, so as not to contaminate the efficiency of their operation (165). His information is not specific, though. It would be interesting to see if

that could be verified.

There is no question the military enterprise is enormous, but to use 'vastness of military enterprise' as a reason for inefficiency is missing the point. How do you define vast? Many industries are 'vast.' A large corporation also has an enormous purchasing operation, buying not only most of the same things the government buys, but also all the inputs necessary for the production of an often wide variety of products. Why is the government an exception here? Size alone does not qualify military procurement as unique. Weidenbaum's evidence to support his generalization was extensive and even entertaining, but a closer look shows all of his anecdotes involve the extensive specifications and regulations imposed by the government. Rather than simply dismissing this by saying the government is large, some real insight could be drawn by looking at the source of regulation. Why has business been done this way for such a long time? What are the incentives for all of the players in the procurement game?

Congressional desire to micromanage arises out of a seemingly fundamental distrust of the Pentagon by Congress. Again Weidenbaum states a general symptom, stopping far short of defining the problem. The question that needs to be asked is, "Does Congress not trust the Pentagon, and if not, how did this relationship come about?" I would argue that question could be reversed as well. Again, the issue here seems to be the incentive structure of both principal (Congress) and agent (Pentagon). There is no question politics cloud procurement analysis, but there is much to be gained if one could untangle the mess and figure out how the long standing rivalries and distrust have arisen. This is easier said than done. I think if you asked a congressman about this, he or she would reply that it is their duty to oversee defense expenditures in the interest of the American people. If you posed the same question to a high ranking military official, the answer might revolve around congressional self interests and overregulation, with the official saying the Pentagon's hands are tied. There is probably truth in both answers. I think procurement research can be greatly advanced by attacking the issue rather than

assuming politics away.

Socioeconomic objectives are often advanced in the defense budget. Weidenbaum argues that such non-defense items tagged on to budget authorizations in the defense budget (pork barrel spending) contribute to the complexity of procurement. This is another political aspect that seems to tie in with congressional micromanagement. Again, if we are to actually define what drives the process, it is not satisfactory to simply state political agendas are advanced through the defense budget. The more important question to be asked concerns how legislators are able to include pork in the defense budget and furthermore, how much is it done and what effect does it have. This is another type of behavior that is well documented and presumed to have been going on for a very long time. Some incentives must drive such repetitive behavior.

I take particular issue with Weidenbaum's final generalization on procurement, human shortcomings. He argues DoD procurement officials are not able to compete with their civilian counterparts due to lack of experience, technical expertise, and training (162). He even goes as far as to say the verbose regulations are an attempt to compensate for this lack of quality (162). I think this conclusion completely misses the boat. Clearly, military procurement officials are not inadequate people. They are college educated (at a minimum), and graduates of some of the finest leadership training in the world (service academies for example). What contract officials for private firms are given is responsibility and freedom to make decisions. At risk of sounding redundant, a broad-based generalization is not acceptable to define the problem. The question that needs to be answered is why does the Congress and the Department of Defense construct the regulations in such a way to prevent full utilization of the skills of their personnel?

In addition to the above questions raised, the same arguments used in section II concerning the uniqueness of the defense industry can be applied to Weidenbaum's characterization of the procurement process. I pointed out that vastness is not unique to military procurement. As far as congressional micromanagement and socioeconomic

agendas go, government involvement varies from enterprise to enterprise. I will not argue that regulation does not affect the procurement process. It most certainly does in a big way, but regulation is present in one form or another in every industry. Firms have safety requirements, environmental standards, employment quotas and government imposed social programs to deal with. Further, on a more broad scope, politics do not have to come out of Washington. Business is full of politics and favoritism, so I think it is naive to say the defense procurement process is inefficient due to political constraints. Finally, human shortcomings are present everywhere as people simply do the best they can with the resources and information available. Thus that is certainly no justification for defense procurement being unique.

The intent of the above two sections is not a critique of Murray Weidenbaum's book. His arguments are useful as a starting point. I chose his framework because it is the most recent in a long line of characterizations of the defense industry. In the coming section, we find many economists use these same arguments as caveats to their economic theories of procurement, without looking closely at these "laundry lists." The next section's intent is to take a survey of what has been done in procurement and move towards a plan to look more deeply and define a specific problem in defense acquisition.

#### **IV. Economic Research in Procurement**

The literature in procurement research is extensive. The major concern of this paper regards the search for the underlying factors that have long driven the government's need to lay out so many minimum specifications in an effort to secure quality. This behavior has been persistent for a long time, despite repeated attempts at reform. Thus the literature review will focus on work that has been done in optimal contract theory, quality, and verifiability of contractual performance. David P. Baron (1993) wrote an article called "Defense Procurement: Politics, Management, and Incentives." It can be regarded as a call to arms for procurement research. Baron lays out a framework of four

crucial areas in procurement: Political Dimensions; Acquisition Management; Hierarchical and Multiparty Arrangements; and Optimal Contract Theory. I will use this very perceptive framework to summarize the quality/verifiability literature.

The first category involves the political dimensions of the procurement process. Many of these issues have been discussed above, such as Congressional micromanagement and pork barrel considerations that go into a program. From a contract design perspective these limitations really affect the acquisition manager's ability to write incentives into the contract because the threat of political intervention weighs very heavily in the process. Hence the government is not able to commit to long term contracts and political pork often leads to revisions and stretch outs.

Rogerson (1989) argues that this threat of Congressional intervention leads the military to over project its budget on a consistent basis. That is, the military asks for more quantity in a given program than it actually needs by increasing the scale of production. By citing a larger capacity, marginal costs appear lower and the Congress approves a level of production lower than the military requested, but close to what they had in mind originally. Thus he concludes that the inefficient production rates often cited are a result of a principal -agent problem between the military and the legislature, and trading off more quality for quantity will not necessarily solve the problem. The military is unable to maximize its capability given a fixed budget. I found this interesting because the Congressional method of approving or rejecting a project seems to contribute largely to this quality bias and overspecification of contracts.

Acquisition management, the second portion of Baron's framework, seems to be a result of the political dimensions as he writes,

The inability to commit to contract terms that provide strong incentives restricts the class of governance mechanisms and contract forms that can be realistically considered (13).

At first glance it seems that procurement officials do not have enough decision making

power as a result of over-regulation which hurts bargaining power since commitment levels are very weak. However, mixed conclusions have been drawn regarding the role of the government procurement official. For instance, Marshall, Meurer, and Richard (1993) argue that too much discretion on the part of the government official leads to favoritism which results in a great deal of sole sourcing and a bias towards established large contractors. They cite a principal-agent problem between the government and its procurement official that results from the fact that the agent is not fully rewarded for efforts to gain surplus for the government but bears all costs in the form of effort expended to find such surplus. I don't disagree with the agency problem stated, but it seems this is a result of the institutional arrangements and incentives given to managers, not discretion on their part.

Baron states that it is hierarchical and institutional arrangements that define the agency problems that seem to be cited in every paper in one form or another. Oliver Williamson is one of the major contributors in this arena, and lays out the whole procurement process and its well documented shortcomings in terms of institutional arrangements. He too argues that discretion presents inefficiency in a procurement contract. Williamson suggests both defense officials and contractors prefer contract specifications which are difficult to verify. The more difficult a provision is to verify, the more discretion an official has in defending what has happened. This, he says, is a result of the institutional hierarchy in the government which includes many formal junctures in the process that are critical to the program's survival. Hence the procurement official's incentives are to look good during these reviews and the easiest way to do that is through a great deal of uncertainty about what has been done. Similarly, the contractor prefers non-verifiable outcomes because he can attribute such problems as cost overruns and delays to uncertainty, not his own performance. This revelation that both parties incentives are in fact compatible leads to the conclusion that the attainment of efficiency requires less task uncertainty and more verifiability to reduce the discretion of all parties

involved (Williamson 250).

Rogerson (1989) argues that regulatory institutions in defense procurement are necessary to create prizes for innovation in the form of profits to defense contractors. This is due to informational and incentive constraints that are inherent in the institutional hierarchy of procurement. He verifies his theoretical result with an empirical study of the aerospace industry and derives several interesting policy implications. Although the focus of this paper is not on innovation (which most of his recommendations are about), there is one that stands out. Rogerson suggests that different pricing rules should apply to different defense contracts, while now the process is standard. That is, pricing rules should vary depending on how much innovation is required. That suggests more standard products should receive less economic profit. This is evidence regarding the importance of examining the nature of the product in a procurement study.

Given the political dimensions and institutional hierarchy which create agency problems, the issue of designing a contract still has not been addressed. After all, it is the contract that lays out the incentives for all parties involved, which ultimately will determine the efficiency of the outcome. Baron makes two noteworthy broad conclusions on this subject. First, he says the importance of the product and its performance should not be simply taken as given, but instead as an element of choice in the contracting process (15). I should note that in this literature performance receives much more weight than product. Second, he calls for the delegation of more responsibility to program managers through making intervention more difficult (17). Limiting the amount of intervention and renegotiation is seen (by some) as an area where programs could be made shorter and costs controlled. Thus I see two essential areas of contracting to explore: 1) The ex ante specifications of performance and quality and how they result in ex post verifiability; and 2) The role of the product in determining the completeness of a contract, the discretion of the procurement official, and the specificity of the outcome required.

I will begin with a general review of the theory of the provision of quality in



procurement. All recent work in this area uses some form of the model developed by Laffont and Tirole (1993). They set up their model on the premise that quality is often difficult to clearly describe *ex ante*, specify in a contract, and have verified in court. They examined whether or not the procurement process is likely to provide the appropriate amount of quality.

The first situation they modelled was a sole source contract where quality and this was premised on an interesting characterization of the product in question. Laffont and Tirole argued that the provision of incentives to obtain quality under the uncertainty DoD faces depends on whether the product could be defined as a search or experience good. A search good is one in which characteristics are observable before purchasing, while an experience good is one in which quality is only observed after purchasing, which is a common characteristic of a weapons system.

The authors conclude there is a direct trade off between incentives to provide quality and incentives to control cost. Thus the optimal contract depends on the contractor's desire to maintain a reputation. An interesting issue brought up over sole-source negotiations is that of DoD's institutional incentives to provide quality, which would lead them to lobby for low-powered incentive schemes (low priority on cost control). This, however conflicts with Weidenbaum's report that 79 percent of DoD contracts are fixed-fee, which was cited above. This is another example of the product potentially being very important in determining optimal DoD behavior.

Laffont and Tirole also analyze procurement in the form of bidding versus the above discussion on negotiated sole sourcing. This theory may be valuable for one who wants to examine procurement outside the context of weapons systems. The theory is based on the government evaluating prospective contractors on both technical and managerial characteristics. It is interesting that they point out that there is a cost-quality trade-off but an auction only considers cost. Thus there are potential problems in the discretion given to DoD.

The so-called quality bias seems to receive attention at one point or another in many procurement papers, but Rogerson (1990) provides a particularly attractive theory. Many argue that the military could be more effective with larger numbers of less sophisticated weapons, saying the military derives private consumption value from technology that is greater than that of society. In contrast, Rogerson argues that the institutional organization itself results in excessive quality even when the agent (DoD) gets no private value from this quality. He suggests a precommitment to fixed budget levels and overlapping service jurisdictions as potential remedies to the overprovision of quality. Although the quantity versus quality argument is attractive from a cost standpoint, I think it would be hard to justify when the subject of human lives comes up. Nevertheless, Rogerson's institutional remarks are interesting.

From the theory of Laffont and Tirole there have been several works in the area of quality that build on their framework. Lewis and Sappington (1991) focus on the difficulties that arise when quality cannot be perfectly observed by a third party. The inability of a third party to verify performance creates problems in enforcing a contract. These difficulties can arise either from intangibles that define quality (eg. reliability or training costs), or from the nature of the product. For example the Air Force and Lockheed might understand the performance of an F-16, but a judge in a contract dispute may not.

Lewis and Sappington model this problem using a formal model similar to that of Laffont and Tirole, using a non-repeated game between procurer and contractor. I should note that this model is appropriate in the case of a weapons system, but it may be difficult to apply to a standard product procured by the military. The authors assume that both procurer and contractor prefer the level of delivered quality to be observable or verifiable. This is interesting because Williamson argued the opposite and supported his theory quite well. Lewis and Sappington say the government should prefer verifiability because this should lower the cost of quality which should in turn increase welfare and the equilibrium

level of quality. The contractor would prefer verifiability because a higher quality supplied should increase his bargaining power for profits. The authors conclude if quality is verifiable there is an optimal two-part tariff that leads to efficient production and pricing, but the underprovision of quality because the contractor has more information about initial capability which will be understated to pad profits.

If quality is not verifiable then a two-part tariff cannot be linked to quality. The producer will deliver more quality only if there is a premium paid above marginal cost. This distortion results in less than efficient output, as in the Rogerson article. Both parties obtain less surplus. Although the article involved some simplifications and the big assumption that increased quality means increased quantity, the authors made some cautious policy statements. They argue it may be beneficial for the government to pay a premium above marginal cost when quality is not verifiable, that the uses of second-sourcing may be limited to cases of verifiable outcomes, and stress the mutual advantages of verification. Perhaps it would be interesting to see if a contract for a verifiable outcome is written differently than one where quality is more difficult to observe.

Lewis and Sappington's results on verifiable performance are elegant but it is difficult to imagine too many products in which quality is perfectly observable. Hermalin and Katz (1991) preface their paper on the idea that compensation should be contingent on performance and again point out the difficulties in verifiability. The authors derive the result that a fully verifiable outcome can be obtained even with incomplete information or an imperfect court. These theoretical results are based on the assumption that the contractor is risk averse, while the government is risk neutral, so the government bears all the risk. They model the procurement process where the key stage is a renegotiation process to settle disputes. The parties over time see a distribution of court rulings based on evidence, so the renegotiation stage becomes a bargaining game with symmetric information due to inferences made on prior decisions. Again, this is a nice theoretical result but it is hard to see it in practice. Still, an important empirical study by Crocker

and Reynolds (1992) shows the usefulness of specifying an incomplete contract to balance the benefits of limiting ex post opportunism with the ex ante costs of specifying a complete contract. This result points in the direction of really taking a hard look at the extensive specifications on a defense contract along with the costs expended in monitoring and inspection by the government.

Hermalin and Katz compare their assumptions to reality, pointing out the costs of monitoring to gather evidence for renegotiation, Congressional intervention, and limits on government's ability to commit to renegotiate. Still there are two points of interest that result: 1) Compensation should be based only on observable variables; and 2) Confronted with an example of waste in procurement, one cannot simply explain the situation as being due to difficulty in performance measurement. This suggests someone needs to look even deeper to the source or the existence of a specific problem.

## V. Conclusions and Recommendations

Although a majority of the results summarized in section IV. are theoretical in nature and not empirically verified, there are some interesting conclusions about the incentives and institutions that are prevalent in defense procurement. In addition these results lead to recommendations in many different areas that seem to make perfect sense in designing optimal contracts. Unfortunately, there seems to be a large gap between theory and reality. Such results have been well known for some time, while procurement reform comes up short time after time. Again, we observe the same behavior reoccurring over a long period of time. There must be something driving that behavior that resists the forces of change.

I am not trying to suggest the government should be able to adapt every reform recommended by a theoretical economic study. I am suggesting a different type of study could be more beneficial in explaining the process. In the above sections, I challenged the age old generalizations about the defense industry and acquisition. The traditional procurement literature draws topics largely based on those generalizations. I think someone needs to go deeper and wipe the slate clean, trying to begin with an open mind and no bias about how the government does business.

In doing so, the question will now shift from "How can we fix it?" to "What is broken?" or better yet, "Is it broken?" That is, the focus must be on trying to define the true process that drives both government and contractor behavior. Rogerson has gone a long way in doing so by looking at the institutional hierarchies involved. Still, he hasn't found out why those institutions persist if they are so inefficient. I propose work needs to be done to take a good hard look at exactly how business is done and see if it is in fact inefficient. From that point, then the focus can shift to what makes it inefficient.

In order to do such a study, there must be some benchmark of efficiency. One such benchmark might be the private sector. Over time, a private industry adapts very well, within the bounds of regulation and the information it has. It is not difficult to see

that in most industries, if a firm is not efficient relative to its competition, it will not survive. Therefore, the private sector seems to be a reasonable benchmark of efficiency in comparison to the government.

If a reasonable comparison could be made between defense acquisition and private sector acquisition, a great deal of insight could be gained. By empirically comparing the two methods of contracting, we could see if there is a statistically significant difference in the way they do business. From that point, if there is in fact a difference, we can look at what drives such behavior, perhaps leading to an explanation of why certain practices in defense procurement have endured so long.

The key to performing such a comparison is in product selection. It is important that one does not compare apples with oranges. Therefore, an excursion outside the world of weapons systems must be made. One area that is particularly interesting is medical equipment. I suggest this area because it seems to parallel weapons acquisition more closely than a more standard product. One can not argue medical equipment is not advanced technology. In addition, like fighter aircraft, ships, or tanks, it is a classification of product that is continually being advanced to higher levels, with a great deal of effort focused on improvement. There is a tremendous amount of costly research and development involved. Perhaps most intriguing is the quality factor. Just like we do not want the second best fighter jet, we do not want second rate surgical equipment either. Both involve human lives at risk, so I believe there is a similar attention to detail.

I do not claim the two areas are without differences. Most importantly, it is the government that drives defense research and new programs, while medical equipment is developed in the private sector (although some areas are heavily subsidized). Before attempting a comparison, more work needs to be done in documenting exactly what the differences and similarities are.

The benefits of using medical equipment are twofold. First I can do a direct comparison between how the government and private sector buy medical equipment. A

1991 General Accounting Office study suggests DoD should mimic the private sector in buying medical supplies, and in fact many efforts are under way to do so. It would be interesting to see if the same holds true in equipment as well. Second, an added benefit of using this product would involve potential comparisons to the way government and private sector develop new systems, taking into account differences between weapons systems and medical equipment.

A comparison between government and private sector acquisition will hopefully shed some light on what drives the defense acquisition process. Rather than take past generalizations of government behavior as given, I plan to challenge those generalizations in trying to find first if they are accurate, and second why the behavior has taken place. Hopefully a more clear definition of the process (and perhaps problem) can lead to more clear insight on the direction out defense industry should take in meeting its future challenge of national security.

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